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Title: METHOD FOR DETECTING A ZERO-POINT ERROR OF A CORIOLIS GYROSCOPE AND CORIOLIS GYROSCOPE USING SAID METHOD

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BACKGROUND

Field of the Invention

The present invention relates to Coriolis gyros. More particularly, this invention pertain to a method for determining the zero-point error of a Coriolis gyro.

~~The invention relates to a method for determining the zero-point error of a Coriolis gyro.~~

Description of the Prior Art

Coriolis gyros~~,~~ (~~which are~~ also known ~~referred to~~ as "vibration gyros") are increasingly employed ~~being used to an increasing extent~~ for navigation ~~purposes, they have~~ . Such devices include a mass system that ~~which~~ is caused to oscillate. Such ~~This~~ oscillation is generally a superimposition of a large number of individual oscillations. The ~~These~~ individual oscillations of the mass system are initially independent of one another and ~~can~~ each may be regarded in the ~~an~~ abstract ~~form~~ as a "resonator" ~~resonators~~. At least two resonators are required for operation of a vibration gyro~~. one of these resonators~~ . A first resonator is artificially stimulated to oscillate, with such ~~these~~ oscillations ~~being~~ referred to below ~~in the following text~~ as a "stimulation oscillation". A ~~the~~ second resonator is stimulated to oscillate only when the vibration gyro is moved or rotated. That is ~~Specifically~~, Coriolis forces occur ~~in this case~~ which couple the first resonator to the second resonator,

draw energy from the stimulation oscillation of the first resonator, and transfer the ~~this~~ energy to the read oscillation of the second resonator. The oscillation of the second resonator is referred to below ~~in the following text~~ as the "read oscillation". In order to determine movement ~~movements~~ (in particular rotation ~~rotations~~) of the Coriolis gyro, the read oscillation is tapped off and a corresponding read signal (e.g. ~~for example~~ the tapped-off read oscillation signal) is analyzed ~~investigated~~ to determine whether any changes ~~have~~ occurred in the amplitude of the read oscillation that measures ~~which represent a measure for the~~ rotation of the Coriolis gyro. Coriolis gyros may be in the form of either ~~both~~ an open loop ~~system and~~ or a closed loop system. In a closed loop system, the amplitude of the read oscillation is continuously reset to a fixed value (preferably zero) by ~~via respective~~ control loops.

~~In order to further illustrate the method of operation of a Coriolis gyro, one example of a closed loop version of a Coriolis gyro will be described in the following text, with reference to Figure 2.~~

Figure 2 is a schematic diagram of a closed loop Coriolis gyro 1. The ~~A Coriolis~~ gyro 1 ~~such as this~~ has a mass system 2 that can be caused to oscillate and is referred to below as a ~~and which is also referred to in the following text as a~~ resonator 2 (in contrast to ~~This expression must be distinguished from~~ the "abstract" resonators, ~~which have been~~ mentioned above, which represent individual oscillations of the "real" resonator). As already mentioned, the resonator 2 may be regarded as a

system composed of two "resonators" (a first resonator 3 and a second resonator 4). Each of ~~Both~~ the first and ~~the~~ second resonators ~~resonator~~ 3, 4 is ~~are each~~ coupled to a force transmitter (not shown) and to a tapping-off system (not shown). ~~The~~ Noise ~~which is~~ produced by the force transmitter and the tapping-off system ~~systems~~ is ~~in this case~~ indicated schematically by ~~the~~ noise 1 (reference symbol 5) and ~~the~~ noise 2 (reference symbol 6).

The Coriolis gyro 1 includes ~~furthermore has~~ four control loops. A first control loop is employed ~~used~~ for controlling the stimulation oscillation (i.e. the frequency of the first resonator 3) at a fixed frequency (resonant frequency). The first control loop has a first demodulator 7, a first low-pass filter 8, a frequency regulator 9, a VCO (voltage controlled oscillator) 10 and a first modulator 11. A second control loop controls ~~is used for controlling~~ the stimulation oscillation at a constant amplitude and includes ~~has~~ a second demodulator 12, a second low-pass filter 13 and an amplitude regulator 14.

Third and fourth control loops are used for resetting ~~those~~ forces that ~~which~~ stimulate the read oscillation. ~~In this case,~~ The third control loop includes a third demodulator 15, a third low-pass filter 16, a quadrature regulator 17 and a second modulator 18. The fourth control loop comprises ~~contains~~ a fourth demodulator 19, a fourth low-pass filter 20, a rotation rate regulator 21 and a third modulator 22.

The first resonator 3 is stimulated at its resonant frequency $\omega 1$. The resultant stimulation

oscillation is tapped off, ~~is~~ demodulated in phase by means of the first demodulator 7, and a demodulated signal component ~~is~~ passed to the first low-pass filter 8 that removes the sum frequencies ~~from it~~. The tapped-off signal is ~~also~~ referred to below ~~in the following text~~ as the tapped-off stimulation oscillation signal. An output ~~signal~~ from the first low-pass filter 8 is supplied to a frequency regulator 9 that ~~which~~ controls the VCO 10 as a function of the applied signal ~~that is supplied to it~~ so that the in-phase component essentially tends to zero. For this ~~purpose~~, the VCO 10 sends ~~passes~~ a signal to the first modulator 11, which ~~itself~~ controls a force transmitter so that a stimulation force is applied to the first resonator 3. When ~~if~~ the in-phase component is zero, the first resonator 3 oscillates at its resonant frequency ω1. It should be mentioned that all of the modulators and demodulators are operated on the basis of ~~this~~ resonant frequency ω1.

The tapped-off stimulation oscillation signal is also ~~furthermore~~ passed to the second control loop and ~~is~~ demodulated by the second demodulator 12. The ~~whose~~ output of the second demodulator 12 is passed through the second low-pass filter 13, whose output signal is, in turn, applied ~~supplied~~ to the amplitude regulator 14. The amplitude regulator 14 controls the first modulator 11 as a function of such ~~this~~ signal and of a nominal amplitude transmitter 23 such that the first resonator 3 oscillates at a constant amplitude (i.e. ~~that is to say~~ the stimulation oscillation has ~~a~~ constant amplitude).

As has already been mentioned, movement or

rotation of the Coriolis gyro 1 results in Coriolis forces (indicated by ~~the term~~ $FC\bullet\cos(\omega 1\bullet t)$ in the drawing) that ~~which~~ couple the first resonator 3 to the second resonator 4, causing ~~and thus cause~~ the second resonator 4 to oscillate. A resultant read oscillation at ~~the~~ frequency $\omega 2$ is tapped off~~,~~ so that a corresponding tapped-off read oscillation signal (read signal) is supplied to both the third and fourth control loops. In the third control loop, this signal is demodulated by means of the third demodulator 15, the sum frequencies ~~are~~ removed by the third low-pass filter 16, and the low-pass-filtered signal ~~is~~ supplied to a ~~the~~ quadrature regulator 17 whose output ~~signal~~ is applied to the third modulator 22 so ~~such~~ that corresponding quadrature components of the read oscillation are reset. Analogously ~~to this~~, the tapped-off read oscillation signal is demodulated in the fourth control loop by means of a ~~the~~ fourth demodulator 19. It then passes through a ~~the~~ fourth low-pass filter 20 and ~~the correspondingly low pass-~~filtered signal is applied ~~on the one hand~~ to a ~~the~~ rotation rate regulator 21. The ~~whose~~ output ~~signal~~ of the rotation rate regulator 21 is proportional to the instantaneous rotation rate and ~~which~~ is passed as the rotation rate measurement ~~result~~ to a rotation rate output 24 and is applied ~~on the other hand~~ to the second modulator 18, which resets the corresponding rotation rate components of the read oscillation.

A Coriolis gyro 1 as described above can ~~may~~ be operated ~~not only~~ in either a double-resonant form or ~~but also~~ in a form in which it is not double-resonant. When ~~If~~ the Coriolis gyro 1 is operated in a double-resonant form, ~~then~~ the frequency of $\omega 2$ of the read oscillation is

approximately equal to the frequency $\omega1$ of the stimulation oscillation. ~~While~~ In contrast, when it is operated in a form in which it is not double-resonant, the frequency $\omega2$ of the read oscillation differs from the frequency $\omega1$ of the stimulation oscillation. In the case of double-resonance, the output signal from the fourth low-pass filter 20 contains ~~corresponding~~ information about the rotation rate, while, when it is not operated in ~~a~~ double-resonant form, ~~on the other hand, it is~~ the output signal from the third low-pass filter 16 contains the rotation rate information. A doubling switch 25 which selectively connects the outputs of the third and fourth low-pass filters 16, 20 to the rotation rate regulator 21 and to the quadrature regulator 17 is provided for switching ~~in order to switch~~ between the double-resonant and non- double resonant modes.

Due to inevitable ~~Unavoidable~~ manufacturing tolerances, ~~mean that~~ it is not possible to avoid the force transmitter system that ~~which~~ stimulates the first resonator (stimulation oscillation) while also slightly stimulating the second resonator (read oscillation). The tapped-off read oscillation signal ~~is~~ thus includes ~~composed~~ of a part due to ~~which is caused by~~ Coriolis forces and a part ~~which is~~ (undesirably) due to ~~caused by~~ manufacturing tolerances. The undesirable part results in the Coriolis gyro having a zero-point error whose magnitude is~~, however, unknown, since it is~~ not possible to distinguish between the ~~these~~ two parts when tapping off ~~the tapped-off~~ read oscillation signal.

~~The object on which the invention is based is to provide a~~

~~method by means of which the zero-point error described above can be determined.~~

SUMMARY AND OBJECTS OF THE INVENTION

It is therefore the object of ~~The object on which~~ the present invention ~~is based is~~ to provide a method for determining the zero-point error due to manufacturing tolerances in a Coriolis gyro ~~by means of which~~ the zero-point error described above can be determined.

The present invention addresses the above object by providing, in a first aspect, a method for determining the zero-point error of a Coriolis gyro. A disturbance force is applied to the resonator of the Coriolis gyro to bring about a change in the stimulation oscillation of the resonator. A change in the read oscillation of the resonator, produced by a partial component of the disturbance force, is extracted, as a measure of zero-point error, from a read signal that represents the read oscillation of the resonator.

In a second aspect, the invention provides a Coriolis gyro. The gyro is characterized by a device that includes a disturbance unit that applies a disturbance force to the resonator of the Coriolis gyro to modulate the stimulation oscillation of the resonator. A disturbance signal detection unit determines a disturbance component, produced by a partial component of the disturbance force, contained in a read signal (which represents the read oscillation) as a measure of the zero-point error.

The preceding and other features of the invention

will become further apparent from the detailed description that follows. Such description is accompanied by a set of drawings. Numerals of the drawings, corresponding to those of the written description, point to the features of the invention with like numerals referring to like features throughout.

~~One exemplary embodiment of the invention will be explained in more detail in the following text with reference to the accompanying figures, in which:~~

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic diagram of a Coriolis gyro based on the method of the invention; ~~and~~

Figure 2 is a schematic diagram of a Coriolis gyro in accordance with the prior art;

Figure 3 is a diagram for illustrating ~~shows a sketch to explain~~ the interaction of a resonator, a force transmitter system and a tapping-off system in a Coriolis gyro;

Figures 4a through ~~to~~ 4d are a series of diagrams for illustrating ~~show a sketch to explain~~ the forces and oscillation amplitudes of ~~for~~ a Coriolis gyro with double resonance;

Figures 5a through ~~to~~ 5d are a series of diagrams for illustrating ~~show a sketch to explain~~ the forces and oscillation amplitudes of ~~for~~ a Coriolis gyro near double resonance; and

Figures 6a through ~~to~~ 6d are a series of diagrams for illustrating ~~show a sketch to explain~~ the method according to the invention.

~~In the drawings, parts and/or devices which correspond to those in the figures are identified by the same reference symbols, and will not be explained once again.~~

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

~~First of all,~~ The general ~~method of~~ operation of a Coriolis gyro is ~~will be~~ explained in the form of a vector diagram illustration (Gaussian plane) below. ~~once again with reference to Figures 3 to 5~~,. In this regard, reference will be made to Figures 3, 4A through 4D and 5A through 5D.

Figure 3 is a diagram for illustrating the interaction of a resonator, a force transmitter system and a tapping-off system in a Coriolis gyro. It ~~Figure 3 shows,~~ schematically~~,~~ represents a Coriolis gyro as~~, to be more precise~~ a system 40 comprising a resonator (not shown), a force transmitter system 41 and a tapping-off system 42 ~~in a Coriolis gyro~~. ~~In addition,~~ Possible oscillations x (stimulation) and y (read) are additionally indicated that ~~, which~~ are coupled to one another by Coriolis forces resulting from ~~as a result of~~ rotations at right angles to the plane of the drawing. The x oscillation (complex) is stimulated by the alternating force with ~~the~~ complex amplitude Fx (in this case, only the real part Fxr). The y oscillation (complex) is reset by the alternating force at the complex amplitude Fy with

the real part Fyr and the imaginary part Fyi. (The rotation vector exp(i*ω*t) are in each case omitted.)

Figures 4a through 4d are a series of diagrams for illustrating the forces and oscillation amplitudes of a Coriolis gyro with double resonance. That is, they ~~Figures 4a to 4d~~ show the complex forces and complex oscillation amplitudes for an ideal Coriolis gyro with the identical ~~same~~ resonant frequency of ~~the~~ x and y oscillations (~~double resonance)~~. The force Fxr and the stimulation frequency of the gyro are controlled ~~so as~~ to produce a purely imaginary, constant x oscillation. This is accomplished ~~achieved~~ by means of an amplitude regulator 14 that ~~, which~~ controls the magnitude of the x oscillation, and a phase regulator 10, which controls the phase of the x oscillation. The operating frequency ω1 is controlled so ~~such~~ that the x oscillation is purely imaginary~~, that is to say~~ (i.e. the real part of the x oscillation is ~~regulated to~~ zero.)

The Coriolis force during rotation, FC, is now purely real, since the Coriolis force is proportional to the speed of the x oscillation. If both oscillations have the same resonant frequency, then the y oscillation, caused by the force FC, is as illustrated in Figure 4d. Should ~~If~~ the resonant frequencies of the x and y oscillations differ slightly, then complex forces and complex oscillation amplitudes will occur~~, as~~ . This is illustrated ~~shown~~ in Figures 5a through ~~to~~ 5d. In particular, this results in a y oscillation stimulated by FC, as shown in Figure 5d.

When double resonance is present, the real part of the tapped-off y signal is zero~~, but~~ It is not if double resonance is not present. In both cases, the Coriolis force FC is zeroed. In the case of reset gyros this is accomplished by a regulator for Fyr, which compensates for FC. In the case of Coriolis gyros ~~which are~~ operated with double resonance, the imaginary part of y is zeroed by means of Fyr, and the real part of y is zeroed by means of Fyi. The bandwidth of the two control processes is approximately 100 Hz.

The method of ~~according to~~ the invention will now be explained ~~in more detail in an exemplary embodiment, and~~ with reference to Figure 1. The ~~a~~ resetting Coriolis gyro 1' ~~is~~ additionally includes ~~provided with~~ a disturbance unit 26, a demodulation unit 27, a control unit 28, a fifth low-pass filter 29 and a multiplier 30.

The disturbance unit 26 produces an alternating signal of ~~at a~~ frequency ωmod, which is added to the output signal from the amplitude regulator 14. As an alternative, band-limited noise can also be used as a disturbance signal instead of the alternating signal. Furthermore, this alternating signal is supplied to the demodulation unit 27. The collated signal which is obtained in this way (output signal from the amplitude regulator and alternating signal) is supplied to a (first) modulator 11, whose corresponding output signal is applied to a force transmitter (not shown), and thus to the resonator 2. As a result ~~In consequence~~, an alternating force that ~~which~~ corresponds to the alternating signal is also applied to the resonator 2. Such ~~This~~ alternating

force can be observed, after "passing through" the resonator 2, in the form of a disturbance component in the tapped-off read oscillation signal.

In this example, ~~in order~~ to determine the disturbance component, the signal ~~which is~~ emitted from the rotation rate regulator is subjected to a demodulation process ~~which is~~ carried out by the demodulation unit 27 ~~and which takes place~~ at the frequency ωmod (disturbance frequency). The signal (disturbance component) obtained ~~in this way~~ is filtered by the fifth low-pass filter 29 and ~~is~~ supplied to the control unit 28. The signal ~~which is~~ supplied to the control unit 28 represents a measure of the zero-point error. The control unit 28 produces an output signal as a function of the signal ~~that is~~ supplied to it. Such ~~, which~~ output signal is supplied to the multiplier 30 and is in such a form that the disturbance component of the tapped-off read oscillation signal is controlled to be as small as possible. The multiplier 30 multiplies the collated signal (output signal from the amplitude regulator and alternating signal) ~~which is~~ supplied to it by the output ~~signal~~ from the control unit 28, and, thus, produces an output signal that ~~which~~ is added to the signal ~~that is~~ emitted from the rotation rate regulator. ~~In consequence,~~ The bias of the Coriolis gyro is thus reset. The signal ~~which is~~ supplied to the demodulation unit 27 may alternatively also be the signal which is supplied to the rotation rate regulator 21, or ~~which is supplied~~ to the quadrature regulator 17, is emitted from the quadrature regulator 17. The signal ~~which is~~ supplied to the demodulation unit 27 may also be the tapped-off read oscillation signal itself. In the latter

case, the operating frequency ω must also be accounted for ~~taken into account~~ during the demodulation process.

~~Furthermore,~~ In principle, it is possible to feed the output signal from the multiplier 30 into the rotation rate control loop at any desired point (not only directly upstream of the second modulator 18~~)~~, i.e. ~~that is to say~~ at any desired point between the point at which the read oscillation is tapped off and the third modulator 22). Analogous considerations apply to the feeding of the disturbance signal into the quadrature control loop.

~~The method according to the invention which has just been described can also be explained as follows, with reference to Figures 6a to 6d.~~

Reference is now made to Figures 6a through 6d, a series of diagrams for illustrating the method according to the invention. The read oscillation will in general "see" a small proportion of the stimulation force Fxr: kFyx*Fxr as a result of manufacturing tolerances. When the Fyr control loop is closed, Fyr is thus changed by kFyx*Fyr when compared ~~in comparison~~ to the correct value. This results in a corresponding bias as ~~, since~~ Fyr is a measure of the rotation rate.

~~In order~~ To compensate for this error, the amplitude of Fxr is ~~now~~ modulated without any mean value by ~~means of~~ the disturbance unit 26. The modulation frequency (or ~~the~~ frequencies) of the band-limited modulation noise should be chosen so ~~such~~ that the stimulation oscillation is disturbed as little as possible

while ~~, but~~ the rotation rate control loop is disturbed as strongly as possible~~,~~ (via the component KFyx*Fxr.) The error component in Fyr~~,~~ (kFyx*Fxr) is now compensated for by the addition of a controlled component kFyxcomp*Fxr to Fyr in such a way that the modulation in the rotation rate channel disappears. This is achieved ~~done~~ by controlling kFyxcomp, which is emitted from the regulator unit 28 (preferably by software). The input signal to a corresponding regulator (the regulator unit 28) is the signal of Fyr, demodulated synchronously with the modulation frequency. When the regulator is matched, the modulation signal in the rotation rate channel disappears, and there is ~~thus~~ no need for a blocking filter for the modulation frequency in the rotation rate output.

In this case, the wording "resonator" means the entire mass system (or part of it) that ~~which~~ can be caused to oscillate in the Coriolis gyro~~, that is to say,~~ (e.g. with reference to Figure 2, that part of the Coriolis gyro which is annotated with the reference numeral ~~number~~ 2.)

A major discovery on which the invention is based is that an artificial change to the stimulation oscillation resulting from the application of appropriate disturbance forces to the resonator can be observed in the tapped-off read oscillation signal: the change (modulation) of the stimulation oscillation also results in a change in the read oscillation due to ~~because of~~ the manufacturing tolerances of the Coriolis gyro. That is, ~~In other words:~~ the disturbance force is applied essentially to the first resonator, but a partial component of this

disturbance force is also applied to the second resonator. The "penetration strength" of a disturbance such as this to the tapped-off read oscillation signal is thus a measure of the zero-point error ("bias") of the Coriolis gyro. If, therefore, the strength of the disturbance component ~~which is~~ contained in the read signal is determined and is compared with the strength of the disturbance force (change in the stimulation oscillation), the zero-point error can be derived ~~from it~~. A disturbance component signal which is proportional to the disturbance component can then be used directly to compensate for the zero-point error.

The disturbance forces are preferably produced by disturbance signals which are supplied to appropriate force transmitters, or are added to signals which are supplied to the force transmitters. By way of example, a disturbance signal can be added to the respective control signals for control of the stimulation oscillation, in order to produce a disturbance force.

The disturbance signal is preferably an alternating signal, for example a superimposition of sine-wave signals and cosine-wave signals. Via corresponding force transmitters, an alternating signal of this type produces an alternating force that ~~which~~ modulates the amplitude of the stimulation oscillation. The alternating signal is generally at a fixed disturbance frequency, so that the disturbance component of the tapped-off read oscillation signal can be determined by means of an appropriate demodulation process, which is carried out at the said disturbance frequency.

The disturbance frequency of the disturbance signal/the disturbance force preferably has a period which is substantially shorter than the time constant of the stimulation oscillation and ~~but is~~ of the same order of magnitude ~~as~~ (or ~~is~~ greater than) the time constant of the Coriolis gyro. One alternative is to employ ~~use~~ band-limited noise as a disturbance signal in the place ~~instead~~ of an alternating signal. In such ~~this~~ case, the disturbance component is demodulated from the read signal by correlation of the noise signal with the signal that ~~which~~ contains the disturbance component, (~~for example~~ e.g. the tapped-off read oscillation signal).

The method described above can be used both for an open loop and for a closed loop Coriolis gyro. In the latter case, the zero-point error can be compensated for as follows: a linear combination is formed of a controlled part of an alternating signal, which produces the stimulation oscillation, preferably including the disturbance signal, and an alternating signal which results in the read oscillation being reset.~~, and~~ This is passed to a rotation rate control loop/quadrature control loop for the Coriolis gyro. The controlled part is ~~in this case~~ controlled so ~~such~~ that the change in the read oscillation~~, as~~ (determined from the read signal~~,~~) becomes as small as possible as a result of the modulation (i.e. ~~that is to say~~ the disturbance component).

The disturbance component may, for example, be determined directly from the tapped-off read oscillation signal. The expression "read signal" covers this signal as well as the signal ~~which is~~ applied to a quadrature

regulator in a quadrature control loop, or ~~is~~ emitted from it, as well as ~~and~~ the signal ~~which is~~ applied to or ~~is~~ emitted from ~~it~~ a rotation rate regulator in a rotation rate control loop.

~~The invention furthermore provides a Coriolis gyro which is characterized by a device for determining the zero-point error of the Coriolis gyro. The device has:~~
~~- a disturbance unit which applies a disturbance force to the resonator of the Coriolis gyro such that the stimulation oscillation of the resonator is modulated,~~
~~- a disturbance signal detection unit, which determines a disturbance component which is contained in a read signal (which represents the read oscillation) and has been produced by a partial component of the disturbance force, as a measure of the zero-point error.~~

If the disturbance force results from an alternating force at a specific disturbance frequency, the disturbance signal detection unit has a demodulation unit by means of which the read signal is subjected to a demodulation process (a synchronous demodulation at the disturbance frequency). This results in the disturbance component being determined from the read signal. Alternatively, band-limited noise may be used as the disturbance signal.

The Coriolis gyro is preferably resetting~~, that is to say~~ (i.e. it has a rotation rate control loop and a quadrature control loop). In ~~the case of~~ a resetting Coriolis gyro, a control unit is advantageously provided ~~in order~~ to compensate for the zero-point error. A ~~The~~

control unit produces a linear combination of a controlled part of an alternating signal, that ~~which~~ produces the stimulation oscillation (preferably including the disturbance signal) and an alternating signal. This ~~,~~ ~~which~~ results in resetting of the read oscillation~~,~~ and passing the ~~passes this~~ collated signal to the rotation rate control loop/quadrature control loop of ~~for~~ the Coriolis gyro. The linear combination of ~~the~~ signals is ~~in this case~~ controlled by the control unit so ~~such~~ that the disturbance component of the read oscillation, as determined from the read signal, becomes as small as possible. The zero-point error of the Coriolis gyro is thus compensated ~~for~~.

The disturbance signal detection unit preferably determines the disturbance component from a signal that ~~which~~ is emitted from a rotation rate regulator in the rotation rate control loop. ~~, with~~ The control unit in this example adds ~~adding~~ the linear combination of ~~the~~ signals to an output signal from the rotation rate regulator.

While the invention has been described with reference to its presently-preferred embodiment, it is not limited thereto. Rather, the invention is limited only insofar as it is defined by the following set of patent claims and includes within its scope all equivalents thereof.

~~Patent claims~~

What is claimed is:

1. A method for determining the zero-point error of a Coriolis gyro (1'), wherein

- the resonator (2) of the Coriolis gyro (1') has a disturbance force applied to it such that a change in the stimulation oscillation of the resonator (2) is brought about, and
- a change in the read oscillation of the resonator (2), which is produced by a partial component of the disturbance force, is extracted from a read signal which represents the read oscillation of the resonator (2) as a measure of the zero-point error.

2. The method as claimed in claim 1, characterized in that the disturbance force is an alternating force which modulates the amplitude of the stimulation oscillation.

3. The method as claimed in claim 2, characterized in that the disturbance force has a disturbance frequency whose period is substantially shorter than the time constant of the stimulation oscillation but is of the same order of magnitude as or greater than the time constant of the Coriolis gyro.

4. The method as claimed in claim 2 or 3, characterized in that the change in the read oscillation is detected by subjecting the read signal to a demodulation process on the basis of the disturbance frequency.

5. The method as claimed in claim 1, characterized in that the disturbance force is produced by a disturbance signal which is band-limited noise.

6. The method as claimed in one of the preceding claims, characterized in that a linear combination is formed of a controlled part of an alternating signal, which produces the stimulation oscillation, and an alternating signal, which results in the read oscillation being reset, and is passed to a rotation rate control loop/quadrature control loop for the Coriolis gyro, in such a way that the change in the read oscillation determined from the read signal becomes as small as possible.

7. A Coriolis gyro (1'), characterized by a device for determining the zero-point error of the Coriolis gyro (1'), having:

- a disturbance unit (26) which applies a disturbance force to the resonator (2) of the Coriolis gyro (1') such that the stimulation oscillation of the resonator (2) is modulated,
- a disturbance signal detection unit (27), which determines a disturbance component which is contained in a read signal (which represents the read oscillation) and has been produced by a partial component of the disturbance force, as a measure of the zero-point error.

8. The Coriolis gyro (1') as claimed in claim 7, characterized by a rotation rate control loop/ quadrature control loop.

9. The Coriolis gyro (1') as claimed in claim 8, characterized by a control unit (28), which forms a linear combination of a controlled part of an alternating signal, which produces the stimulation oscillation, and an alternating signal which results in the read oscillation being reset, and passes it to the rotation rate control loop/quadrature control loop for the Coriolis gyro (1'), with the control unit controlling the linear combination of the signals such that the disturbance component, which is determined from the read signal, of the read oscillation becomes as small as possible.

10. The Coriolis gyro (1') as claimed in claim 9, characterized in that the disturbance signal detection unit (27) determines the disturbance component from a signal which is emitted from a rotation rate regulator (21) in the rotation rate control loop, and the linear combination of the signals is added to an output signal from the rotation rate regulator (21).

ABSTRACT

In a method for determining the zero-point error of a Coriolis gyro ~~(1')~~, the resonator ~~(2)~~ of the Coriolis gyro ~~(1')~~ has a disturbance force applied to it such that a change in the stimulation oscillation of the resonator ~~(2)~~ is brought about.~~, and~~ A change in the read oscillation of the resonator ~~(2)~~, caused ~~which is brought about~~ by a partial component of the disturbance force, is extracted from a read signal which represents the read oscillation of the resonator ~~(2)~~ as a measure of the zero-point error.